**Plenary 2 – Why Students May Struggle: Marian**

Starting activity

Use blue for activities

Create a sentence activity:

Improper, fraction, simple, challenging, 8

e/g/ It is simple to write 8 as an improper fraction but more challenging to understand it when it’s in that form.

The improper fraction 8/4 is simple to write as a whole number, but it is more challenging to write 88/5 as a mixed number.

What do we ask kids to do and know?

|  |  |
| --- | --- |
| Gr 1 | •Divide whole objects into equal sized parts and use fraction words  *-Sometimes we want to tell how much there is when there is less than a whole.* |
| 2 | • Determine relationship between number of fraction parts and size (investi)  • Regroup fractional parts in wholes (concrete)  • Compare using concrete materials (no notation)  *-When you divide the same thing into more parts, the parts are smaller.*  *-If you can divide a whole into many equal parts, you could put the parts together again to make the whole.*  *-If you want to know which part is more, sometimes you can just look; other times, you can overlap the parts to tell.* |
| 3 | • Divide whole objects AND SETS into equal parts and use fraction names (not notation)  *- Not only can you divide measures into equal parts, you can think of a group of objects as a single whole; although we usually think about creating equal parts as dividing, we can also think about it fractionally.*  *- A unit fraction can be thought of as dividing a whole into equal parts.* |
| 4 | • Represent fractions using concrete materials, words, and standard fractional notation, meaning of denominator and numerator  • compare and order fractions considering size and number of parts  • compare fractions using benchmarks  • demonstrate and explain relationship between equiv fractions, using concretes  • count forwards by halves, thirds, fourths, and tenths beyond one  *- The numerator and denominator of a fraction tell you different things about the fraction.*  *- You need to know what the whole is to interpret or compare fractions.*  *- The same object(s) can represent different fractions, depending on what the whole is.*  *- There are many ways to represent any given fraction.*  *- Every fraction has more than one name. If you are using the same whole, then you can tell whether you are identifying the same amount by overlapping the two representations.*  *- There is always more than one strategy for comparing fractions, but for particular fractions, one strategy might be easier to use than another. Many of the strategies involve renaming fractions.*  *- It might be helpful to think of a fraction like a/b as a sets of 1/b. You can then count by 1/b s.* |
| 5 | • represent, compare, and order with like denominators including improper and mixed using tools  • demonstrate and explain concept of equiv fractions using concretes  • describe multiplicative relationships between quantities by using simple fractions  (fractions for probabilities)  *- There are fractions that are not parts of wholes. These fractions might be a different name for a whole or they might represent an amount between two wholes.*  *-There are a number of benchmarks that can be of use when comparing fractions, particularly when some fractions are greater than 1.*  *- Mixed number representations of fractions of greater than 1 usually give a better sense of the size of the fraction than improper fraction representations.*  *- There is always more than one strategy for comparing fractions, but for particular fractions, one strategy might be easier to use than another.*  *- Every fraction has more than one name. If you are using the same whole, then you can tell whether you are identifying the same amount by overlapping the two representations.*  *- Fractions are used as a way to compare measures or sets. For example, we might say that one set or one length is 2/3 as long as another set or length.* |
| 6 | • represent, compare, order with unlike denominators- proper, improper, mixed  • represent ratios using concretes, pictorial and standard fractional notation  (fractions for probabilities)  *- There is always more than one strategy for comparing fractions, but for particular fractions, one strategy might be easier to use than another.*  *- Ratios used to compare parts of sets to the whole set can easily be represented as fractions of sets, but fractions are also useful to compare parts of sets to each other.* |
| 7 | • represent, compare and order fractions  • divide whole numbers by simple fractions  • use variety of mental strategies to solve problems involving + and – of fractions  *- There is always more than one strategy for comparing fractions, but for particular fractions, one strategy might be easier to use than another.*  *- Dividing by a fraction involves finding how many of that fraction makes the other number.*  *- Adding and subtracting fractions only involves “counting” if the denominators are the same, but is more complicated if they are not.*  *- Adding and subtracting hold the same meaning for fractions as for whole numbers.*  *- Adding and subtracting fractions often involves renaming them to make the calculation easier.*  *- There are always many strategies for calculating with fractions.* |
| 8 | • represent, compare and order rational numbers  • translate between equivalent forms of a number  • use estimation with solving operations with … fractions  • represent the multiplication and division of fractions, using variety of tools  • solve problems involving +, -, x and ÷ with simple fractions  • solve problems involving proportions using concretes, pictorials and variables  *- There is always more than one strategy for comparing fractions, but for particular fractions, one strategy might be easier to use than another.*  *- One way to compare fractions is to compare the numerator to the denominator.*  *- A non- unit fraction can be interpreted as a quotient. <could have been earlier> Knowing this might help someone figure out the decimal form of a fraction.*  *- Multiplying a number other than 1 by a fraction is equivalent to changing the whole before you interpret the fraction (e.g. 2/3 x ½ means make the ½ the whole before you take 2/3.)*  *- Dividing by a fraction involves finding how many of that fraction makes the other number.*  *- Each operation with fractions holds the same meaning as it did before; knowing this can inform estimating and calculation with those fractions.*  *- A proportion is a statement that two fractions are equivalent.*  *- There are always many strategies for calculating with fractions.* |
| 9 | • simplify numerical expressions involving rational numbers and…  *- Each operation with fractions holds the same meaning as it did before; knowing this can inform estimating and calculation with those fractions.*  *- There are always many strategies for calculating with fractions.* |

**So where might the struggles be and what will bring them to your attention so you can deal with them?**

| Misconception | What could expose the misconception |
| --- | --- |
| • Kids think these parts are not equal since they look different.   |  |  | | --- | --- | |  |  | |  |   This is because the focus has always been on congruent pieces and not equal area pieces. | Do you think this is an accurate picture for 2/3 or not?  Explain. |
| • Kids see a fraction like 3/4 and think they are supposed to “do something” with the 3 and the 4.  This is because students just are in the habit of doing stuff with the numbers they see. | Nothing to do, but something to watch for. |
| • Kids do not know this is 2/5 since the shaded parts are separated.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  |  |  |  | | Make sure to present these situations and talk about 2 fifths. |
| • Kids may not realize that the diagram above shows both 2/5 and 3/5 (and 5/5).  This is because there is too much emphasis on the shaded part instead of listing all fractions in a situation. | You might ask kids to describe all fractions they see in a given situation, e.g.  Open question: Create a model or draw a picture that shows both 1/6 and 5/6 at the same time.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  | |  |  |  |  |  |  | |
| Kids do not believe that 1/3 **of the blocks** are red.    This is because the focus is always on area.  Notice we say “fraction of the blocks” not just fraction”. | e.g. Provide red, yellow, green and blue pattern blocks.  Ask for a student to show ½, then 1/3, then 1/6 and then ¼.  It is good, not bad, to use materials that are usually used for a different model.  Another idea:  Possible open question: Draw a picture that shows 1/4 , but it doesn’t look like it.  (might do a ¾ diagram, might do the not-adjacent, might do the not congruent parts, might do the part of set meaning where part of whole might be there too) |
| • Kids do not have enough exposure to fractions of measures other than area, e.g. masses, capacities, lengths, etc. so often can’t apply fraction concepts to thee other situation. For example—how would you fill this cup 1/3 full? | Possible open question: How could you fill a cup with water and be sure it is ½ full? 1/3 full?  How could you cut off 1/3 of a piece of ribbon? |
| • Kids might think that 1/3 is always less than 1/2 but it depends on the wholes being equal. | K says 1/3 is less than ½ since 3 is more than 2.  L says 1/3 is more than ½ since  J says 1/3 could be more or less than ½. It depends.  With whom do you agree? Why? |
| • Kids might that that 1/3 is more than 1/2 since 3 is more than 2. |
| • They might not realize why it’s hard to compare 2/5 and 3/8 without a picture or object but it’s easy to compare 2 anythingths with 5 anythingths without seeing them. | Suppose you don’t have any fraction manipulatives.  Which pairs of fractions would you find easiest to compare? Why?  5/12 5/43 4/9 7/9 |
| • Kids might not realize that to compare 1/10 and 8/9, it’s easy just to compare to benchmarks.  Many students are only exposed to the notion of comparing by using equivalent fractions or using manipulatives. | Possible open question: Two fractions have different numerators and different denominators, but they are really easy to compare. What might they be? |
| • Kids might have difficulty comparing to 1/2 if the fractions are not simple; for example, they know that 3/8 < ½ but not that 99/200 is also < ½.  This is because students do not get enough practice with anything but standard fractions. | Possible open question: Another fraction is super close to ½. What might it be? |
| • Kids might assume that 3/5 = 5/7 since you do the same thing to the numerator and denominator.  Students just hear” do the same to the top and the bottom”. They learn a rule without understanding. | Ask students to use fraction strips.  Start with a proper fraction one time and an improper fraction another time, e.g. 2/3 and 4/3.  Have them add 1 to both numerator and denominator and compare those fraction pieces.  Possible open question: How can you convince someone that if you add the same amount to a numerator and denominator, the fraction changes. |
| • Kids might assume that 5/6 = 7/8 since both times the numerator is 1 less than the denominator.  Students make up their own rules when they don’t really understand what is going on. | Ask students to find three fractions where the denominator is 1 more than the numerator on a fraction tower.  They tell what they notice about their relative sizes and explain why. |
| • Kids might assume that 6/10 > ¾ since each part of the first fraction is greater than the corresponding part of the other. | Why is 40/100 < 2/3 even though 40 and 100 are more than 2 and 3?  Possible open question: One fraction has a greater numerator and a greater denominator than another, but it’s still smaller. What could the two fractions be? |
| • Kids may not realize that to decide what this picture represents, you need to know the whole. | Why might someone call this ¾ but someone might call it 1 ½?  Possible open question: Draw a picture that some people might think shows 5/4, but some people might think shows 5/8 and both make sense. |
| • Kids may not understand why a/b = a ÷ b when a is not 1.  We often do not really explain this, but expect students to just accept it. | Ask students to figure out how much you would get in each situation:    4 people sharing 2 items  3 people sharing 2 items  5 people sharing 3 items  Then have students figure out what they notice. |
| • Kids might add 2/3 + 3/4 as 5/7  This actually makes sense for some meanings of fractions. Also, the format of stacked fractions encourages this sort of reaction. | Ask students to decide which should be more WITHOUT adding.  2/3 + 3/4 or 2/3 + 1/3  So what does that mean for the value of 2/3 + 3/4? |
| • Kids might think that 12/5 is really 5/12 since they believe that fractions are always parts of wholes. | Perhaps we should emphasize a fraction as a number between wholes rather than part of a whole. |
| • Students might struggle with the mechanics of adding or subtracting fractions or dividing them. | You can use more meaningful models rather than symbolic rules for calculations.  e.g. show grid model for + and – and show fraction strip model for ÷  Possible open question: You perform a calculation involving the fraction 2/3 and one other fraction. The result is 1/4. What operation and with what other fraction? |
| • Students might not have any sense of the answer when you divide fractions since they don’t know what dividing means.  One reason might be the way we read calculations.  We could read 2 ÷ 1/3 as how many 1/3s are in 2 instead of as 2 divided by 1/3. | Possible open question (fraction towers are provided): You divide two fractions and the answer is just a little more than 2. What could the fractions have been? |

I think the breakouts should involve teachers in seeing examples of these misconceptions that you found in the project.

Should also look at GC diagnostics and how they helped focus on some of the misconceptions kids might have

Should also think about creating other activities that would help you ensure these misconceptions don’t exist.

Myths

• That you should not use a common denominator to multiply fractions. (F)

• That 2 ½ /3 is not a fraction. (T)

• That you can divide numerators and divide denominators to divide fractions (T).

• That the only way to add fractions is to get a common denominator (F).

• That the only best to compare fractions is to get a common denominator (F).

• That fractions are always parts of a whole. (F)

• That if you add the same amount to numerator and denominator, you can’t get an equivalent fraction (F)

• That if you add numerators and add denominators, you get a fraction between the two you started with (T).

• That only part-to-whole ratios can be described using fractions (F).

• That you can divide fractions without inverting and multiplying (T).

• That you can start fraction thinking using length or area (T).

• That it’s a good idea for students to draw their own pictures of fractions, dividing up wholes into fraction amounts, rather than using pre-divided amounts(T/F).

• That using grid paper to learn about fractions is a good bridge between part of whole and part of set meanings. (T)

• That even though the curriculum suggests adding fractions should precede multiplying, it makes more sense to start with multiplying since it’s easier (F)\_

• That we don’t need fractions since we are metric (F)

• that student work has to be written to “count” (F)

• that there are only 3 ways to consolidate a lesson- gallery walk, bansho, congress (F)

• that vocabulary is paramount (F)

• that there always has to be a context (F)

• that you can’t plan any consolidation before you start (F)

• that success criteria are rubrics (F)

• that you can’t monitor closely enough if you let kids investigate (F)

• That open questions are a good way to expose misconceptions (T)

• That struggling students need bite-size pieces (F)

Myths

• That you should not use a common denominator to multiply fractions. (F)

• That 2 ½ /3 is not a fraction. (T)

• That you can divide numerators and divide denominators to divide fractions (T).

• That the only way to add fractions is to get a common denominator (F).

• That the only really correct way to compare fractions is to get a common denominator (F).

• That fractions are always parts of a whole. (F)

more pedagogy myths

• don’t need fractions since we are metric

• that it has to be written to “count”

• that there are only 3 ways to consolidate

• that vocabulary is paramount

• that there always has to be a context

• that you can’t plan any consolidation before you start

• that success criteria are rubrics

• that you can’t monitor closely enough if you let kids investigate

**Plenary 2**

* which question is the easiest for you?

389 + 477

2/3 +3/8

3/2012 + 5/2012

* as adults, we struggle with fractions

[www.youtube.com/watch?v=lBdASZNPIv8](http://www.youtube.com/watch?v=lBdASZNPIv8)